

BKCASE™

*Body of Knowledge and Curriculum
to Advance Systems Engineering*

Garry Roedler, ESEP

Engineering Outreach Program
Manager

Lockheed Martin Corporation

garry.j.roedler@lmco.com

Don Gelosh, Ph.D., CSEP-Acq

Deputy Director, Workforce
Development

DDR&E/Systems Engineering/
Mission Assurance

Donald.Gelosh@osd.mil

29 April 2010

www.bkcase.org

Report Documentation Page				Form Approved OMB No. 0704-0188	
Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.					
1. REPORT DATE 28 APR 2010		2. REPORT TYPE		3. DATES COVERED 00-00-2010 to 00-00-2010	
4. TITLE AND SUBTITLE BKCASE(TM) Body of Knowledge and Curriculum to Advance Systems Engineering				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Lockheed Martin Corporation,Cherry Hill,NJ,08002				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited					
13. SUPPLEMENTARY NOTES Presented at the 22nd Systems and Software Technology Conference (SSTC), 26-29 April 2010, Salt Lake City, UT.					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT Same as Report (SAR)	18. NUMBER OF PAGES 26	19a. NAME OF RESPONSIBLE PERSON
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified			

Project Overview

What is BKCASE?



- Project to create:
 - Body of Knowledge in systems engineering (SEBoK)
 - Graduate Reference Curriculum in Systems Engineering (GRCSE™)
- Started in September 2009 by Stevens Institute of Technology and Naval Postgraduate School with primary support from Department of Defense
- Project will run through 2012
- Intended for world-wide use



BKCASE Staffing



1. BKCASE is an open, collaborative project with international participation sought from academia, industry, government, related projects, and professional societies.
2. Art Pyster (Stevens) is Principal Investigator (PI); Dave Olwell (NPS) is Co-Principal Investigator. Alice Squires, Stephanie Enck and Nicole Hutchinson are key researchers.
3. BKCASE sought 30-40 active volunteer authors + several hundred volunteer reviewers. Nearly 40 authors have already signed up.

More BKCASE Staffing



4. Each participating professional society will provide at least one active author. (INCOSE has agreed to participate and fund 3 authors. IEEE Systems Council has 2.)
5. Authors are invited onto the project by the Principal Investigators (PI); anyone is welcome to be a reviewer.
6. BKCASE will pay for authors to attend workshops to the extent possible, analogous to GSwE2009.
7. BKCASE will generally not pay for the labor of authors or reviewers.

Expanding List of Authors



<i>Rick Adcock, Cranfield University and INCOSE, UK</i>	<i>Bud Lawson, Lawson Konsult AB, Sweden</i>
<i>Johann Amsenga, Eclipse RDC, South Africa</i>	<i>Alex Lee, Defence Science and Technology Agency, Singapore</i>
<i>Erik Aslaksen, Sinclair Knight Merz, Australia</i>	<i>Ray Madachy, Naval Postgraduate School, US</i>
<i>John Baras, IEEE Systems Council and University of Maryland, US</i>	<i>Andrew McGettrick, Association for Computing Machinery (ACM) Education Board and Education Council</i>
<i>Barry Boehm, University of Southern California, US</i>	<i>Ken Nidiffer, Software Engineering Institute and IEEE Systems Council, US</i>
<i>Cihan Dagli, Missouri University of Science and Technology, US</i>	<i>Dave Olwell, Naval Postgraduate School and BKCASE Co-Principal Investigator, US</i>
<i>J. Ekstrom, Brigham Young University, US</i>	<i>Art Pyster, Stevens Institute of Technology and BKCASE Principal Investigator, US</i>
<i>Alain Faisandier, Map Systeme, France</i>	<i>Garry Roedler, Lockheed Martin and National Defense Industrial Association Systems Engineering Division, US</i>
<i>Tim Ferris, University of South Australia and INCOSE, Australia</i>	<i>Jean-Claude Roussel, EADS, France</i>
<i>Kevin Forsberg, Center for Systems Management and INCOSE, US</i>	<i>Sven-Olaf Schulze, Berner & Mattner Systemtechnik GmbH, Germany</i>
<i>Richard Freeman, Air Force Center for Systems Engineering, US</i>	<i>Jon Gye Shin, Seoul National University, South Korea</i>
<i>Sandy Friedenthal, Lockheed Martin, US</i>	<i>Hillary Sillitto, Thales Group and INCOSE, UK</i>
<i>Richard Frost, General Motors, US</i>	<i>John Snoderly, Defense Acquisition University, US</i>
<i>Edward Ghafari, ICES Corporation and Defense Information Systems Agency, US</i>	<i>Alice Squires, Stevens Institute of Technology, US</i>
<i>Richard Grzybowski, Corning Incorporated, US</i>	<i>Massood Towhidnejad, Embry-Riddle University, US</i>
<i>Tom Hilburn, IEEE Computer Society and Embry-Riddle University, US</i>	<i>Guilherme Travassos, Federal University of Rio de Janeiro, Brazil</i>
<i>Scott Jackson, University of Southern California, US</i>	<i>Mary VanLeer, Arkansas Scholarship Lottery, US</i>
<i>Michael Krueger, ASE Consulting, US</i>	<i>Brian Wells, Raytheon, US</i>

Our Partners



Also seeking partnership with Project Management Institute and Brazilian Computer Society

Strategy



1. Publish incrementally/iteratively with GRCSE trailing SEBoK
2. Create common vocabulary to facilitate communications among the team
3. Throughout the project, involve professional societies to facilitate quality, acceptance, and their eventual role as stewards
4. Build early consensus and maintain it throughout the lifetime of the project
5. Rely on and include academia, industry, and government from multiple fields for authors and reviewers
6. Extensively leverage volunteer labor for both authoring and review
7. Rely on existing source material wherever possible and involve principals from efforts that created source material wherever possible
8. Leverage the processes used to create GSwE2009 and the NPS Modeling and Simulation Acquisition Curriculum
9. Keep completely open and collaborative at a global level – but authors make content decisions
10. Hold physical workshops every 3 months to synchronize teams and build team relationships – rely on virtual meetings, email, and other collaboration technology at other times
11. Keep the team focused on the value propositions when conflicts arise.

SEBoK Overview

BKCASE Vision and Objectives



Vision

“Systems Engineering competency models, certification programs, textbooks, graduate programs, and related workforce development initiatives around the world align with BKCASE.”

Objectives

1. Create a SEBoK that is globally recognized by the SE community as the authoritative BoK for the SE discipline.
2. Create a graduate reference curriculum for SE (GRCSE – pronounced “Gracie”) that is globally recognized by the SE community as the authoritative guidance for graduate programs in SE.
3. Facilitate the global alignment of related workforce development initiatives with SEBoK and GRCSE.
4. Transfer stewardship of SEBoK and GRCSE to INCOSE and the IEEE after BKCASE publishes version 1.0 of those products, including possible integration into their certification, accreditation, and other workforce development and education initiatives.

SEBoK Value Proposition



1. There is no authoritative source that defines and organizes the knowledge of the SE discipline. Knowledge gap creates unnecessary inconsistency and confusion in understanding the role of SE and in defining SE products and processes.
2. Creating the SEBoK will help build community consensus on the boundaries of SE, including its entanglements with project management and software engineering.
3. A common way to refer to SE knowledge will facilitate communication among systems engineers and provide a baseline for competency models, certification programs, educational programs, and other workforce development initiatives around the world.
4. Common ways to identify metadata about SE knowledge will facilitate search and other automated actions on SE knowledge.

1. The definition of fundamental terms and concepts and primary relationships between those concepts
2. A statement of the principles of SE
3. A description of generally accepted activities, practices, technologies, processes, methods, and artifacts of SE and how they relate to one another
4. How the knowledge of SE varies within individual application domains such as medicine, transportation, and telecommunications
5. References to books, articles, websites, and other sources that elaborate on the information in the SEBoK

Version 0.25 expected in Summer 2010

Table of Contents as of April 2010

1. Executive Summary
2. Introduction (Overview)
 - Purpose of BoK
 - Scope
3. System Concepts
 - a. System Definition – what is a system
 - b. Systems Thinking
4. Fundamentals
 - a. Value/Quality
 - b. Principles of SE
 - c. Integration of other disciplines such as software engineering and project management
 - d. Socio-technical Issues (Context)
 - e. SE Standards
 - f. Application domains (describes each)
5. SE Approach and Practices
 - a. Life Cycles
 - b. Organization
 - c. Management
 - d. Technical
 - e. Agreement
 - f. Specialty Engineering/Design Considerations
6. SE Artifacts
7. SE Applications/Case Studies
8. SE Competency (ethics, statistical modeling, ...)
9. Glossary
10. Other Closing Matter

1. Primary SEBoK users will be:
 - Practicing systems engineers ranging from novices up through senior experts
 - Those responsible for defining and implementing SE processes within organizations, projects, and programs
 - Those responsible for certifying systems engineers and developing certification programs
 - Customers of SE organizations to help them better select and evaluate those organizations
 - Any project manager, engineer, technologist, researcher, or scientist who needs to know about SE
 - Those who educate and train systems engineers
 - The GRCSE author team.
2. Secondary SEBoK users who will use the SEBoK with the support of systems engineers will be:
 - Human resource professionals and other workforce development professionals
 - Senior non-technical managers

GRCSE Overview

How We Got Here



In Spring 2007, 3 phase effort was proposed:

1. A reference curriculum for graduate software engineering with the “right” amount of systems engineering
2. A reference curriculum for graduate systems engineering with the “right” amount of software engineering
3. A fully interdisciplinary reference curriculum for systems and software engineering

Phase 1 Primary Products

- Graduate Software Engineering 2009 (GSWE2009): Curriculum Guidelines for Graduate Degree Programs in Software Engineering
- GSWE2009 Companion Document: Comparisons of GSWE2009 to Current Master's Programs in Software Engineering
- GSWE2009 Companion Document: Frequently Asked Questions on Implementing GSWE2009



Endorsed by INCOSE, NDIA SE Division, Brazilian Computer Society
Sponsored by DoD, IEEE Computer Society and ACM

www.GSWE2009.org

GRCSE Value Proposition



1. There is no authoritative source to guide universities in establishing the outcomes graduating students should achieve with a master's degree in SE, nor guidance on reasonable entrance expectations, curriculum architecture, or curriculum content.
2. This gap in guidance creates unnecessary inconsistency in student proficiency at graduation, makes it harder for students to select where to attend, and makes it harder for employers to evaluate prospective new graduates.

GRCSE is being created analogously to GSwE2009 – in fact, using GSwE2009 as the starting text

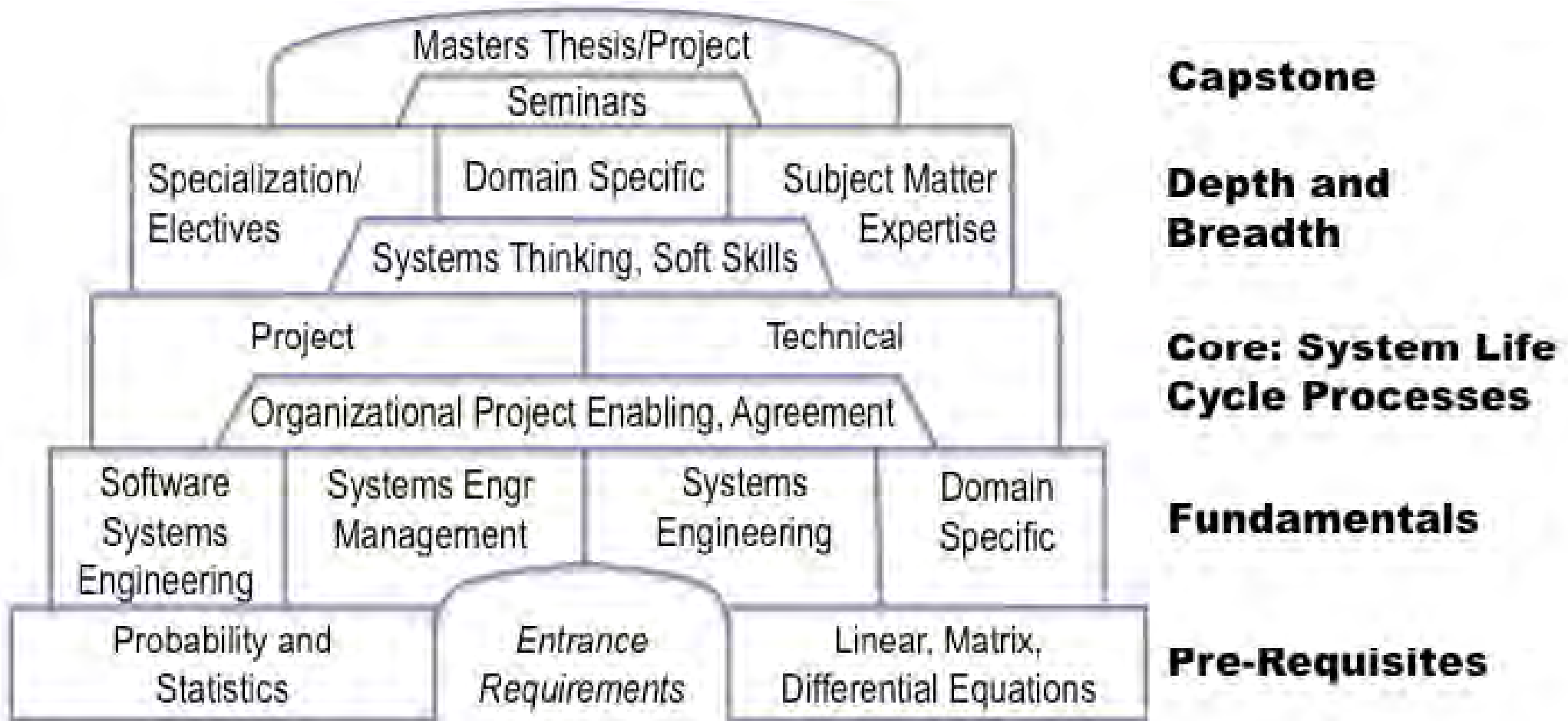
Version 0.25 expected in Fall 2010

Initial GRCSE Structure



- ***Guidance for Constructing and Maintaining GRCSE:*** the fundamental principles, assumptions, and context for the GRCSE authors
- ***Entrance Expectations:*** what students should be capable of and have experienced before they enter a graduate program
- ***Outcomes:*** what students should achieve by graduation
- ***Architecture:*** the structure of a curriculum to accommodate core material, university-specific material, and elective material
- ***Core Body of Knowledge (CBOK):*** material that all students should master in a graduate SE program – derived from SEBoK

Representation of Evolved INCOSE Graduate Reference Curriculum



Reference: Squires, A., & Cloutier, R. (2010). Evolving the INCOSE reference curriculum for a graduate program in systems engineering. *Systems Engineering*, 13(4).

GRCSE Outline as of April 2010



- Intro/front matter
- Curricular Objectives
- Curricular Outcomes
- Entrance expectations
- Curriculum architecture
- Common Body Of Knowledge (CBOK)
- Assessment
- Maintenance / refresh
- Closing matter
- Appendix: catalog of programs / benchmarks

BKCASE State and Summary

BKCASE Products

1. BKCASE will iteratively deliver a SE BoK and a reference curriculum for a master's degree in SE together with supplementary material (i.e., case studies) to facilitate their dissemination and adoption.
2. Products freely available without charge provided credit is given.
3. Ideally, any other SE BoK or curriculum effort would merge with BKCASE and efforts to create or evolve SE competency models and certification programs would closely coordinate with BKCASE.
4. Nominal schedule is:
 - a. SE BoK: Version 0.25 June 2010, Version 0.5 June 2011, Version 1.0 June 2012
 - b. Reference Curriculum: Version 0.25 September 2010, Version 0.5 September 2011, Version 1.0 September 2012

State of BKCASE

- Significant funding support from US Department of Defense
- INCOSE, IEEE Systems Council, IEEE Computer Society Educational Activities Board, the NDIA Systems Engineering Division, and ACM are all participants
- Seeking participation by PMI and Brazilian Computer Society
- Explicitly seek INCOSE and the IEEE to become sponsors and assume maintenance and revision responsibilities after Version 1.0 is published
- First two workshops complete: December 8-9 at Naval Postgraduate School; March 30-31 at ERAU.
- initial teams formed to create Version 0.25; outlines and some content defined; next 3 workshops scheduled; special events at INCOSE IW and EuSEC scheduled; presentation scheduled at SSTC

Expected Impact on Undergraduate SE Programs



SEBoK should directly influence what is taught in undergraduate SE programs by providing community-based consensus on the boundaries, principles, content, and key references of SE

GRCSE should help to better distinguish between graduate and undergraduate education in SE and influence undergraduate education by guiding what is taught in graduate programs



Call for Authors, Subject Matter Experts,
Reviewers and Early Adopters

www.BKCASE.org

[*bkcase@stevens.edu*](mailto:bkcase@stevens.edu)